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The predictive value of lower grade marks in determining upper grade marks within the same school system

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THE PREDICTIVE VALUE OF LOWER GRADE MARKS IN DETERMINING UPPER GRADE MARKS WITHIN THE SAME SCHOOL SYSTEM

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By

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CHAPTER I

INTRODUCTION

In spite of the present growing abundance of standardized tests of achievement and intelligence, teacher's marks are, and in all probability shall continue to be, the universal measure of school work.

Many problems in the management of a school--credit, failure, promotion, retardation, elimination, graduation, honors, recommendations for positions, indeed the entire scholastic machinery are tied up with the assignment of marks. It is little wonder then that school marks have had their accuracy, value, range, assignment and reliability examined, studied, praised, blamed, ridiculed, cussed, and discussed by everyone concerned, (and who is not concerned?) whether they knew anything about the subject or not.

Objective research in recent years has taken the place of concensus of opinion in determining the answer to disputed questions. It is the purpose of this study to determine objectively the answer to the question: To what extent do the marks obtained by a pupil in the lower grades of the Pittsfield School System forecast the marks that will be obtained by the same pupil in the higher grades of that same system?

The first question is, what are lower grades and what are upper grades? For the purpose of this study grades one, two and three are grouped together and labeled the Primary division; grades four, five, and six are grouped together and labeled the Intermediate division; grades seven, eight, and nine are grouped together and labeled the Junior High Division; grades ten, eleven, and twelve are grouped together and labeled the Senior High Division.

The next question is, what is to be the basis of comparison? In this study the basis of comparison is a composite individual division score for each pupil studied made up of the mean (average) score of all the subject marks given by all the teachers in the division under consideration.

The third problem is, what is to be the method of comparison. As this is to be an objective study the statistical method is used as it promises the most objective results.

A brief survey of past studies of related "marks" problems would furnish a background for this study.

It has been known, at least since the beginning of the present century, that there is a vast amount of variation in the manner in which marks are distributed to pupils from teacher to teacher and different schools.

Meyer in 1908 published the distribution of the marks assigned by 40 different professors at the University of Missouri to their students during a five year period. Similar tabulations have been published for Harvard University by Foster in 1911; for the University of Wisconsin by Dearborn in 1910; and for Cornell University by Finklestein in 1913. Trabue in 1924 did much the same thing for five of the larger high schools in northern New Jersey. All of these studies agree in showing extremely wide differences among teachers in the manner of giving marks.

The classic experiment of Starch and Elliot in 1912 and 1913 of examining the variations of teachers' marks by the tabulation of the grades or marks assigned by different teachers to the same piece of work is talked about and quoted wherever marks are discussed.

In this series of investigations two final examination papers in first year high school English were graded by 142 English teachers in any many high schools, one final examination paper in Geometry was graded by 118 teachers of mathematics, and one final examination paper in American history was graded by 70 teachers of history. The differences and variations in these marks as shown by their tabulation is astounding. The marks for any given paper run practically over the entire range of the percentage scale ordinarily used. For example, the marks of the first English paper run all the way from 64 to 98, of the second English paper from 50 to 98, of the geometry paper from 28 to 92, and the history paper from 43 to 90.

This investigation established two conclusions: first, that teachers differ enormously in evaluating the same pieces of work in terms of the ordinary percentage scale; and second, that they differ as much in one subject as in another.

Starch (5) offers four possible reasons for these great differences: (1) difference in the standard of severity or leniency in different schools; (2) differences in the credit or penalty assigned by different teachers to any given fact or error in a piece of work; (3) differences in the standard of severity or leniency of different teachers; and (4) minuteness of the discrimination between successive steps of merit or quality in a given scale of qualities.

He reached the conclusion that factors 3 and 4 are by far the more important ones in producing the large differences of values assigned by teachers to a given piece of school work.

These studies constituted a sufficiently representative sample of the hundreds in existance to make it pretty safe to admit that there is a vast amount of variation in the manner in which marks are assigned to pupils.

Truman Kelly(2) in his "Interpretation of Educational Measurement" as Terman puts it in an effort to develop "One's sensitivity to the existence of the ubiquitous probable error" makes the following statement: "If an average 11 year old in the third grade should transfer to a new school, and if the 3 on his record card should look like a 5 so that he was by mistake placed in a fifth grade, the chances are that it would never be discovered unless the child himself made the fact known."

All this tends to leave one in very grave doubt as to the wisdom of school marks. It is little wonder then that there is a tendency to discontinue giving marks at all.

The data brought to light by this study has strengthened the author's faith and confidence in school marks--reasons and proof will develop with the thesis.

Any data that makes teachers' marks seem ridiculous will, upon investigation, show a very plausable and correctable reason for the ridiculousness. Starch does this in his classical study referred to and states further that when these facts are called to the attention of a group of teachers with suggestions as to a remedy, the improvement is marked.

Kelly is merely using extremes to stress a point to which every school man agrees--marks are a long way from being perfect. However, it is the opinion of the author that they are one of the best measures we have. Evidence will be given to substantiate this opinion as the thesis develops.

In conclusion it might be said that it is necessary to evaluate the achievements of pupils as accurately as possible in order to determine the fruitfulness or wastefulness of learning and teaching school subjects. Furthermore the successful operation of a school demands an accounting of the work of its pupils--school marks offer such a means of accounting.

CHAPTER II

COLLECTION OF DATA.

Shortly after the present Superintendent of Schools, Dr. John F. Gannon, first came to Pittsfield, a permanent individual office record card system was started. Briefly this system works as follows: Each pupil in the Public Schools of Pittsfield has a separate card which is kept in the principal's office of the school the pupil is now attending. This card is first made out when the child enters school and follows the pupil from grade to grade and school to school until graduation.

The office record cards of the pupils considered in this study are at present on file in the principal's office of the Junior High School from which the pupil was graduated. Under the arrangement and revision inaugurated last September, the same office record card will follow the pupil through high school and remain on file in the high school office. Before this change the individuals card went as far as the tenth grade only, a new and separate card being used in high school.

Since in the collection of data for this study the complete record of an individual was not to be found in one place, it was necessary to devise the following plan: First go through every old office record card in each of the three junior high schools with records available, sort out and arrange alphabetically every card of every graduate on which the record is complete from the first grade through the ninth grade, take this list to the high school and check the names of the pupils that have been graduated. By doing this we have a list of students whose complete record from the first grade through high school is available for study.

There were about four thousand old office record cards available in the three junior high schools. Of this number 692 had been graduated leaving a complete record from the first through the ninth grades on their record cards.

Of these 692 junior high graduates 328 had finished the high school leaving a complete record available for study. This does not mean that only 328 of the 692 finished high school--some went to the Catholic Parochial high and consequently their records do not appear.

In the process of more careful study it was found advisable to discard some of the 328 available complete cases for various reasons. For example the record of anyone graduating from high school before June, 1928, was thrown out because before that time marks given may not be a true measure of present tendencies. There were only a few such cards and it was thought best to avoid possible error or criticism by discarding them.

Still others were cast out because of lack of certainty as to the correct name. Some Italian and Polish pupils changed names or the spelling of names when they left the grades thus making the identity not absolutely sure.

Still other throw-outs were due to changes made by the teachers or principals in the numerical or percent scale value of the letter ratings assigned on the cards.

When all unreliable cases were eliminated there were 266 complete dependable pupil records available for study. All data in this thesis are based on that number of cases.

As school grades or marks are assigned in the Pittsfield school system by means of letters and for statistical comparison a percentage scale basis is more easily understood and manipulated so it became necessary to change letter marks to percentage marks. This is often necessary in computing class averages and individual percentile rank or placement with respect to the class as a whole. The common practice is to assign arbitrary numerical values to the various letters as shown in Table II (page 9). Table I shows the numerical step interval of the letter grades as printed on the office record card.

TABLE I

A-----90-100

B-----80- 89

C-----70- 79

D-----60- 69

F----- 0- 59

With the information in Table II the calculation of a pupil's mean or average for a given division consisted of counting the number of A+'s and multiplying it by 98; counting the number of A's and multiplying by 95; counting the number of A-'s and multiplying by 90; and so on thru the B+'s, B's, B-'s, C+'s, C's, C-'s, D+'s, D's, D-'s, and F's. The sum of all marks was divided by the number of marks and the arithmetic mean or pupil average for the division emerged. This process was repeated in each division for everyone of the 266 pupils. When it is remembered that there are 4 divisions for each pupil with about 100 separate marks for each pupil in each division the amount of figuring necessary to obtain a single pupils average for each of the four divisions can perhaps be appreciated.

TABLE II

A+	=	98	C+	=	78
A	=	95	C	=	75
A-	=	90	C-	=	70
B+	=	88	D+	=	68
B	=	85	D	=	65
B-	=	80	D-	=	60
			F	=	40

To reduce possible errors and make computation easier a multiplication table of all numerical grades listed in Table II was made up and referred to for multiplication results.

All computations in this thesis including those necessary to obtain averages were done by the author and checked at least once. In some cases where the answer did not seem reasonable the answer was checked three times.

A median conduct mark was also tabulated for each pupil in each separate division and note made of all cases of sudden rapid change for the better or worse in ratings received both between divisions and within divisions themselves. These conduct marks were left in terms of letters as that is the manner in which they were recorded on the pupil's office record card. A check up after the tabulation of the first hundred cases showed about 90% A's or B's, 8% C's and only 2 cases where D's appeared and then only in one division out of the four. Even though this indicated little hope for anything measurable the tabulation was continued for the remainder of the cases.

As a check on the data collected and tabulated for the 266 cases in this study the percentage of different marks assigned by teachers in the schools under consideration during a current marking period were collected and tabulated.

There was a change inaugurated in September of 1933 in the method of listing marks on report cards. The change however does not effect this study because there is no numerical difference in the results. What was formerly called an A is now a 1, a B is a 2, a C is a 3, a D is a 4, and a F is a 5.

The distribution of marks for the entire graduating class in High School of February 1933 and June 1933 were also obtained as check material on the main data.

CHAPTER III

STATISTICAL INTERPRETATION

It is impossible to show relationships and make comparisons between large groups of scores such as those used in this study unless statistical methods are employed. There are many types of statistical method that may be applied to make data more intelligible and understandable. In this study the following methods are used: (1) graphical, (2) coefficient of correlation (Personian method--Otis modification) and (3) quartile placement or coefficient of correspondence.

As there is some confusion in the use of terms in statistical procedure all terms and methods used in this study will be briefly defined and illustrated to insure clearity.

Table III shows the tabulation of the division scores or averages for each one of the 266 cases included in the study. A number has been substituted for the pupils name.

TABLE III

Student Number	Grades 1-3	Grades 4-6	Comp. 1-6	Grades 7-9	Comp. 1-9	Grades 10-12
1	86	86	86	82	85	84
2	86	84	85	81	84	77
3	84	76	80	76	79	73
4	76	76	76	79	77	69
5	80	77	79	80	79	76
6	83	88	86	84	85	86
7	70	78	74	77	75	81
8	88	88	88	85	87	81
9	85	80	83	83	83	82

Table III (continued)

Student Number	Grades 1-3	Grades 4-6	Comp. 1-6	Grades 7-9	Comp. 1-9	Grades 10-12
10	82	81	82	79	81	78
11	84	80	82	78	81	71
12	86	87	87	82	85	81
13	83	80	82	73	79	77
14	89	89	89	90	89	84
15	83	76	80	79	79	74
16	88	87	88	77	84	74
17	75	76	76	81	77	77
18	83	88	86	80	84	84
19	88	88	88	81	86	81
20	82	83	78	82	79	74
21	77	75	76	75	76	72
22	86	84	85	80	83	78
23	84	84	84	84	84	89
24	88	89	89	87	88	81
25	76	82	79	76	78	69
26	79	85	82	74	79	77
27	79	84	82	84	82	73
28	78	79	79	79	79	78
29	82	80	81	76	79	78
30	83	86	85	83	84	75
31	89	91	90	89	90	93
32	90	83	87	80	84	83
33	79	78	79	78	78	73
34	77	77	77	77	77	79

Table III (continued)

Student Number	Grades 1-3	Grades 4-6	Comp. 1-6	Grades 7-9	Comp. 1-9	Grades 10-12
35	88	83	86	79	83	66
36	78	88	83	87	84	86
37	89	87	88	84	87	76
38	89	88	89	85	87	80
39	87	85	86	87	86	76
40	84	82	83	83	83	72
41	86	89	88	86	87	84
42	77	83	80	85	82	75
43	85	89	87	89	88	88
44	83	82	83	78	81	71
45	88	88	88	80	85	85
46	92	86	89	79	86	74
47	88	87	88	84	86	77
48	87	90	89	82	86	80
49	88	90	89	89	89	88
50	92	89	91	87	89	88
51	89	90	90	88	89	86
52	89	89	89	87	88	80
53	77	77	77	80	78	76
54	89	75	82	80	81	81
55	79	75	77	73	76	76
56	88	84	86	81	84	77
57	80	84	82	79	81	76
58	78	77	78	77	77	75
59	71	77	74	77	75	78

Table III (continued)

Student Number	Grades 1-3	Grades 4-6	Comp. 1-6	Grades 7-9	Comp. 1-9	Grades 10-12
60	91	82	87	80	84	77
61	79	82	81	76	79	69
62	86	84	85	77	82	83
63	88	83	86	84	85	83
64	74	81	78	85	79	84
65	89	86	88	88	88	85
66	85	78	82	76	80	79
67	77	82	80	76	78	69
68	89	86	88	74	83	74
69	86	83	85	80	83	70
70	92	90	91	89	90	82
71	83	87	85	82	84	81
72	84	85	85	83	84	82
73	75	73	74	73	74	71
74	88	86	87	83	86	76
75	86	86	86	87	86	81
76	80	80	80	82	81	84
77	83	79	81	76	79	77
78	72	77	75	84	78	75
79	85	85	85	80	83	73
80	83	84	84	81	83	78
81	84	78	81	72	78	73
82	81	83	82	78	81	84
83	85	87	86	83	85	81
84	85	80	83	80	82	80

Table III (continued)

Student Number	Grades 1-3	Grades 4-6	Comp. 1-6	Grades 7-9	Comp. 1-9	Grades 10-12
85	87	89	88	89	88	79
86	90	87	89	89	89	90
87	83	78	81	78	80	81
88	84	70	77	75	76	78
89	80	75	78	76	77	81
90	88	80	84	74	81	74
91	86	78	82	73	79	80
92	83	81	82	74	79	80
93	84	86	85	83	84	85
94	83	83	83	75	80	78
95	81	83	82	81	82	82
96	82	79	81	76	79	80
97	74	75	75	77	75	80
98	66	77	72	79	74	71
99	75	70	73	75	73	75
100	88	84	86	83	85	86
101	77	75	76	71	74	74
102	77	75	76	71	74	78
103	86	81	83	82	83	83
104	74	73	74	71	73	72
105	80	77	79	83	80	83
106	92	77	85	81	83	82
107	82	84	83	81	82	82
108	83	73	78	79	78	77
109	80	76	78	74	77	65

Table III (continued)

Student Number	Grades 1-3	Grades 4-6	Comp. 1-6	Grades 7-9	Comp. 1-9	Grades 10-12
110	83	77	80	76	79	79
111	73	70	72	76	73	77
112	71	84	78	78	78	79
113	82	85	84	77	81	71
114	80	70	75	74	75	79
115	85	84	85	82	84	81
116	91	83	87	80	85	79
117	89	82	86	78	83	76
118	84	77	81	72	78	79
119	76	79	78	80	78	75
120	87	77	82	79	81	72
121	74	78	76	77	76	80
122	73	73	73	72	73	77
123	88	88	88	86	87	92
124	69	70	70	72	70	72
125	83	76	80	73	77	76
126	86	78	82	78	81	76
127	90	83	87	84	86	85
128	85	81	83	84	83	85
129	78	75	77	76	76	69
130	82	84	83	87	84	84
131	87	82	85	81	83	83
132	76	72	74	74	74	74
133	78	73	76	70	74	70
134	79	80	80	80	80	81

Table III (continued)

Student Number	Grades 1-3	Grades 4-6	Comp. 1-6	Grades 7-9	Comp. 1-9	Grades 10-12
135	74	76	75	82	77	75
136	82	77	80	79	79	76
137	83	82	83	73	79	76
138	82	77	80	72	77	70
139	85	83	84	79	82	72
140	87	78	83	82	82	79
141	71	71	71	72	71	67
142	86	82	84	84	78	77
143	87	77	82	81	82	82
144	81	80	81	82	81	76
145	89	78	84	82	83	82
146	77	82	80	79	79	79
147	86	88	87	87	87	86
148	75	78	77	74	76	73
149	78	77	78	84	80	78
150	92	88	90	88	89	90
151	77	75	77	74	75	69
152	85	86	86	88	86	88
153	87	86	87	78	84	74
154	72	75	74	82	76	81
155	92	79	86	78	83	72
156	92	92	92	84	89	81
157	92	83	88	84	86	87
158	84	82	83	79	82	76
159	76	78	77	75	76	78

Table III (Continued)

Student Number	Grades 1-3	Grades 4-6	Comp. 1-6	Grades 7-9	Comp. 1-9	Grades 10-12
160	77	73	75	84	78	86
161	70	76	73	73	73	75
162	80	80	80	73	78	71
163	82	77	80	71	77	75
164	83	87	85	84	85	84
165	80	89	85	83	84	83
166	84	86	85	83	84	86
167	83	81	82	83	82	89
168	78	80	79	75	78	75
169	78	85	82	82	82	86
170	90	85	88	76	84	71
171	82	84	83	78	81	89
172	83	76	80	73	77	76
173	83	83	83	78	81	83
174	91	83	87	81	85	80
175	75	73	74	76	75	72
176	80	81	81	77	79	76
177	86	83	85	79	83	83
178	76	78	77	76	77	83
179	86	81	84	81	82	67
180	83	83	83	83	83	85
181	61	68	65	65	65	67
182	85	80	83	77	81	79
183	84	83	84	80	82	84
184	71	80	76	74	75	69

Table III (continued)

Student Number	Grades 1-3	Grades 4-6	Comp. 1-6	Grades 7-9	Comp. 1-9	Grades 10-12
185	88	86	87	82	85	85
186	78	87	83	78	81	79
187	75	78	77	77	77	79
188	80	70	75	76	75	70
189	90	87	89	80	86	81
190	75	79	77	77	77	80
191	85	85	85	79	83	76
192	90	89	90	81	87	78
193	92	89	91	89	90	87
194	92	90	91	86	89	88
195	85	83	84	75	81	77
196	92	90	91	87	90	87
197	82	83	83	76	80	80
198	90	83	87	77	83	83
199	78	83	81	84	82	86
200	81	83	82	81	82	83
201	77	79	78	76	77	70
202	86	88	87	86	87	79
203	78	83	81	79	80	70
204	82	85	84	83	83	84
205	92	86	89	85	88	71
206	75	79	77	77	77	70
207	75	75	75	82	77	79
208	76	82	79	78	79	74
209	83	90	87	81	85	82

Table III (continued)

Student Number	Grades 1-3	Grades 4-6	Comp. 1-6	Grades 7-9	Comp. 1-9	Grades 10-12
210	77	86	82	81	81	79
211	88	90	89	81	86	86
212	89	90	90	87	89	84
213	89	91	90	89	90	89
214	78	82	80	76	79	76
215	89	91	90	92	91	93
216	84	84	84	78	82	74
217	88	90	89	92	90	85
218	84	91	88	92	89	93
219	78	82	80	76	79	67
220	87	86	87	79	84	80
221	87	85	86	75	82	77
222	85	85	85	80	83	77
223	89	89	89	78	85	79
224	81	82	82	77	80	72
225	73	87	80	84	81	78
226	74	79	77	72	75	74
227	81	77	79	71	76	77
228	83	86	85	84	84	85
229	80	80	80	80	80	80
230	80	83	82	76	80	85
231	88	87	88	83	86	82
232	88	88	88	87	88	87
233	85	88	87	82	85	80
234	88	90	89	89	89	90

Table III (continued)

Student Number	Grades 1-3	Grades 4-6	Comp. 1-6	Grades 7-9	Comp. 1-9	Grades 10-12
235	86	84	85	79	83	79
236	88	89	89	85	87	81
237	89	82	86	85	85	79
238	86	89	88	79	85	81
239	86	89	88	85	87	79
240	74	81	78	84	80	80
241	67	78	73	72	72	73
242	70	80	75	80	77	79
243	88	87	88	89	88	83
244	84	81	83	80	82	85
245	84	86	85	87	86	86
246	92	91	92	89	91	87
247	92	91	92	89	91	86
248	88	88	88	87	88	87
249	84	84	84	81	83	76
250	89	86	88	84	86	81
251	78	83	81	82	81	87
252	87	87	87	76	83	78
253	86	77	82	74	79	78
254	84	87	86	82	84	84
255	77	87	82	85	83	80
256	85	80	83	79	81	74
257	79	81	80	75	78	76
258	83	84	84	77	81	76
259	90	81	86	85	85	80

Table III (continued)

Student Number	Grades 1-3	Grades 4-6	Comp. 1-6	Grades 7-9	Comp. 1-9	Grades 10-12
260	91	91	91	91	91	92
261	88	88	88	90	89	90
262	92	90	91	89	90	87
263	80	82	81	78	80	72
264	91	91	91	88	90	82
265	91	92	92	91	91	91
266	81	85	83	88	85	95

The graphic method of interpretation is first applied to the data. The distribution of marks in each division is represented by the frequency polygon or line graph.

The method used is the one advocated by Henry E. Garrett(1) in his "Statistics in Psychology and Education."

The frequency polygons obtained in this study do not exactly follow the normal probability curve. The normal probability curve is a bell shaped curve of almost perfect bilateral symetry with the greatest concentration in the center, and the scores falling away by corresponding decrements above and below the central point. Such a curve may be said to represent the relative frequency of accurence of various combinations of a very large number of equal, similar and independent factors, when the chances of the occurrence or non-occurrence of each factor is the same. The normal curve is often called the normal probability curve because it gives the theoretical probabilities of the occurrence of chance phenomena. It is also called the normal frequency curve, because frequency distributions of actual data obtained from the measurement of many variable facts are normal.

Figure I (page 24) shows the distribution of marks for the primary devision. This curve is most decidedly negatively "skewed" which indicated a piling up of scores toward the right or high side of the scale. This implies that too large a percentage of high marks are given in this division since any unselected group, if large enough to constitute a "fair sampling" should give a normal distribution curve unless there is a weakness at some point. The "check" material presented later in this thesis supports the contention that we have a fair sampling. It is therefore a fair conclusion that we have the weakness of too many high marks present.

Figure II (page 25) shows the distribution of marks for the intermediate division.

This curve shows less negative skewness than that of Figure I. However, there is still much piling up of scores on the high side of the scale with a noticable tendency for scores to be more closely grouped about the measure of central tendency. The same weakness is present in this distribution as is present in that of Figure I but to a somewhat smaller degree.

Figure III (page 26) shows the distribution of marks for the junior high division.

This curve conforms fairly well to the general outlines of the normal curve, no great amount of skewness being apparent. However there is a noticable tendency in this division for marks at the two extremes of the scale to be pushed back toward the center thus causing a bulge at the point of central tendency.

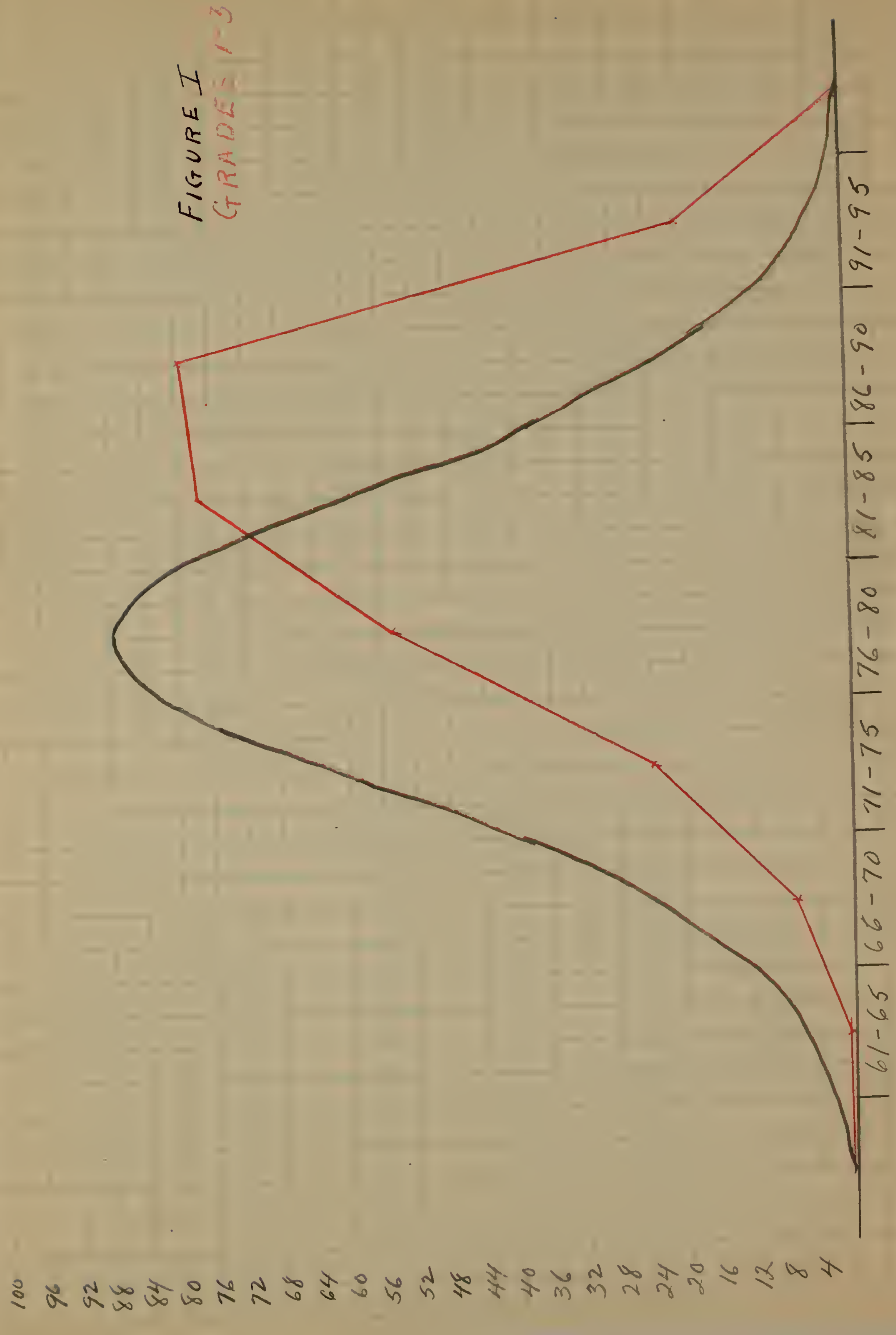
FIGURE I
GRADE 1-3
61-65
66-70
71-75
76-80
81-85
86-90
91-95
4
8
12
16
20
24
28
32
36
40
44
48
52
56
60
64
68
72
76
80
84
88
92
96
100

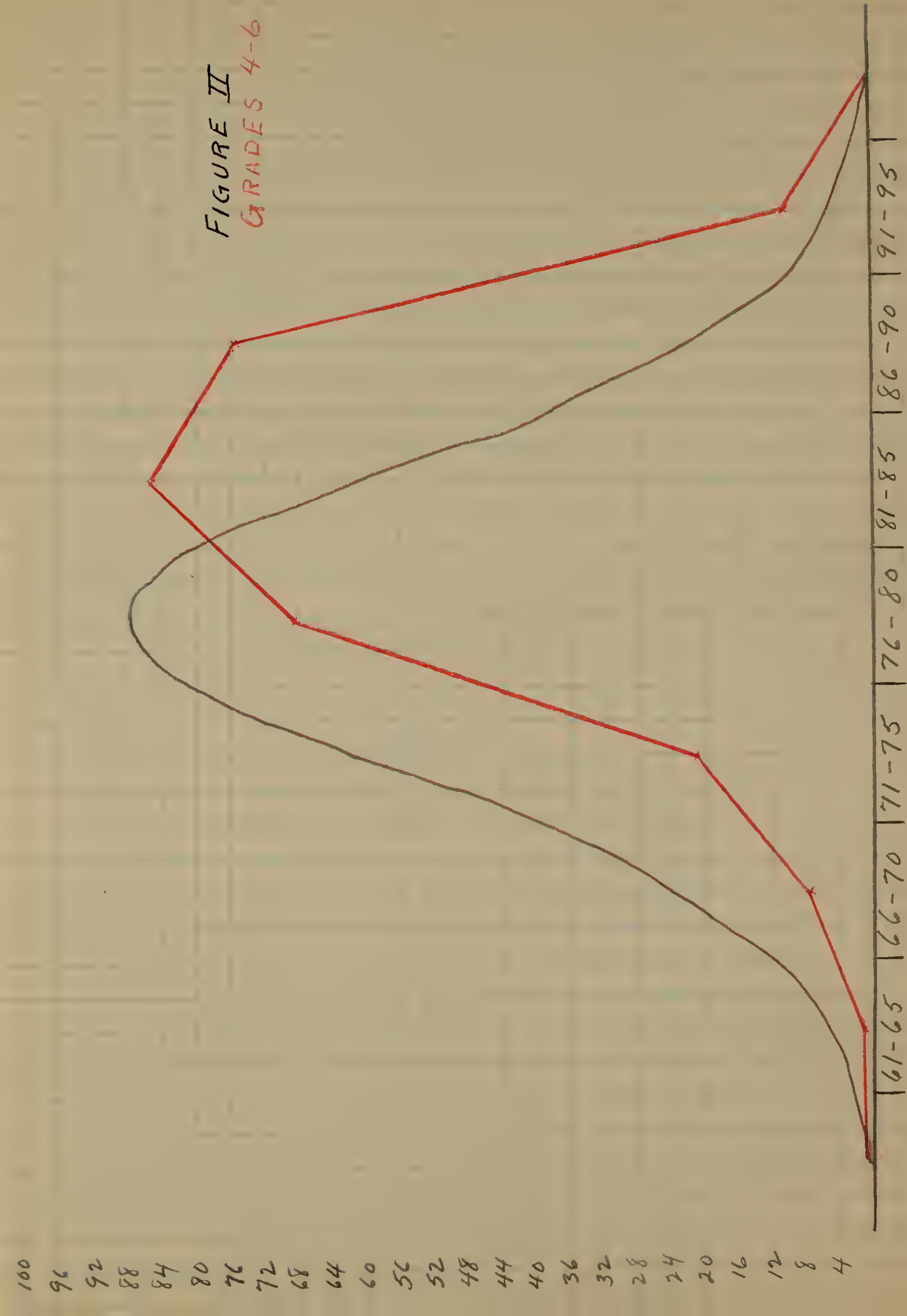
FIGURE II
GRADES 4-6
61-65
66-70
71-75
76-80
81-85
86-90
91-95
4
8
12
16
20
24
28
32
36
40
44
48
52
56
60
64
68
72
76
80
84
88
92
96
100

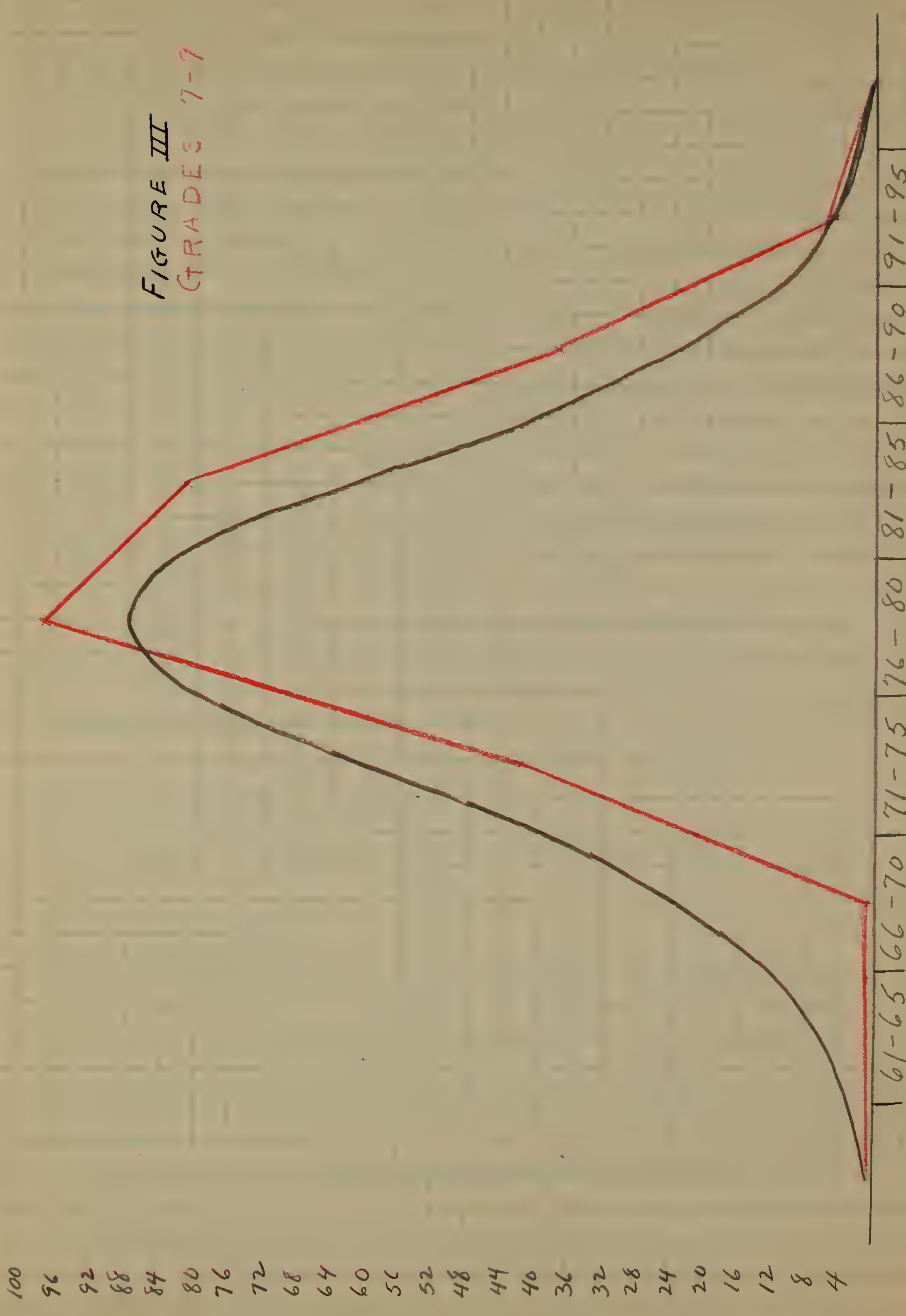
FIGURE III
GRADES 7-7
61-65
66-70
71-75
76-80
81-85
86-90
91-95
100
96
92
88
84
80
76
72
68
64
60
56
52
48
44
40
36
32
28
24
20
16
12
8
4

Figure IV (page 28) shows the distribution of marks for the senior high school division. This curve is the nearest approximation of all to the normal distribution curve.

The passing grade undoubtedly has some effect on all the distributions. A pupil graduating from high school in 1928 entered the first grade in 1916, therefore we must consider any changes in the passing grade in Pittsfield between 1916 and 1933. Seventy was the passing grade generally used throughout the system during the entire period. However during the last eight years of this time it was customary to allow a pupil receiving as low as a 60 in one or two subjects to pass on to the next higher grade. In high school such a mark entitled its receiver to the "points" necessary toward graduation but disqualified him from continuing in the subject.

With the passing grade at 70 it would be necessary to fail a pupil if a lower mark is given. As there is a marked tendency to keep the list of failures small this would tend to make all distributions slightly negatively skewed with a shifting of scores toward the high end of the scale.

Figure V (page 29) shows the separate frequency polygons of figures I - IV on the same scale for the purpose of easier general comparison.

Tables IV, V, VI, and VII represent the tabular distribution of the data shows in Figures I through V. By calculating measure of variability and central tendency from the data contained in these tables and figures, clearer and more understandable tendencies and conclusions may be drawn. The following measures and their method of computation are helpful in the

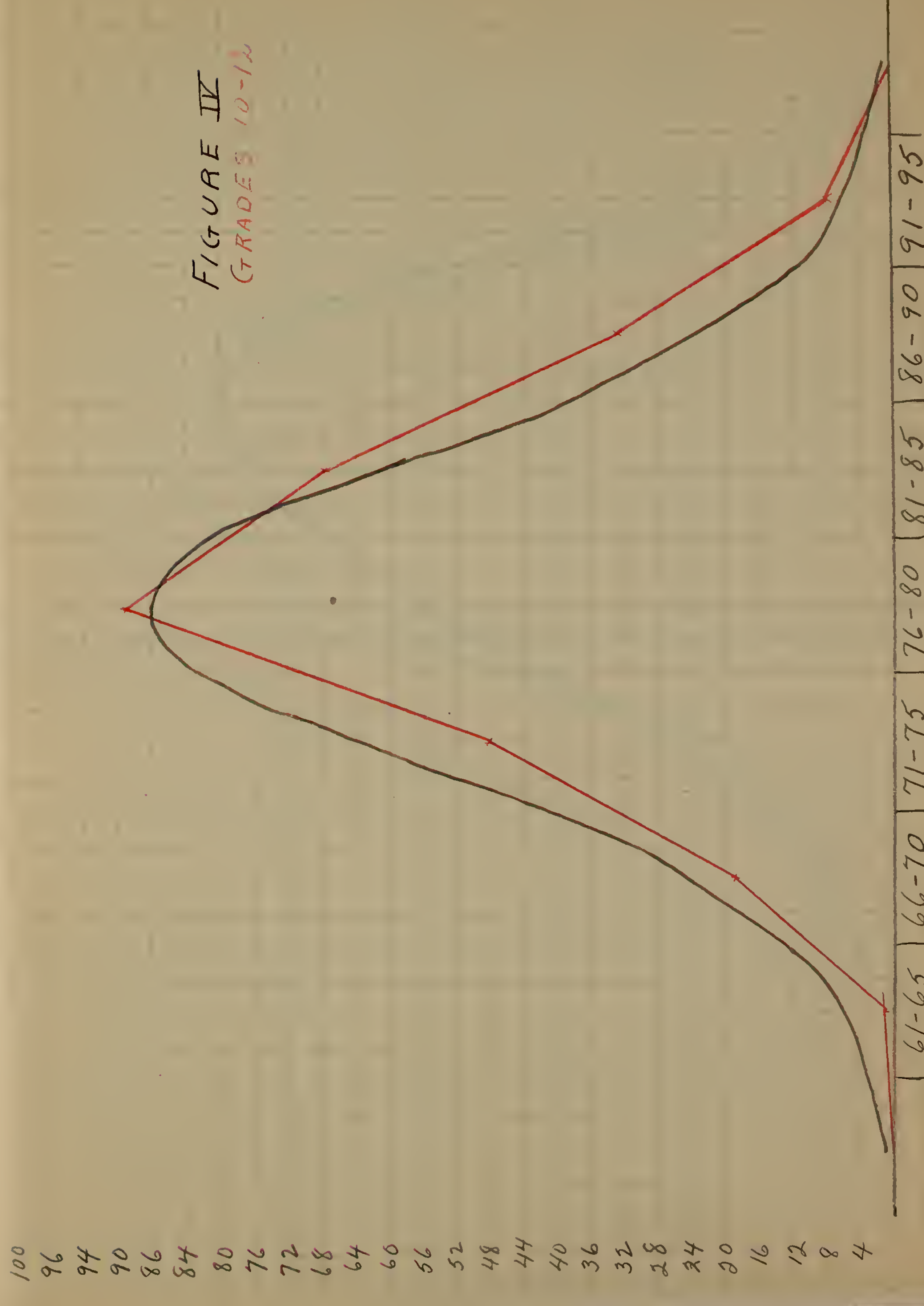
FIGURE IV
GRADES 10-12
61-65
66-70
71-75
76-80
81-85
86-90
91-95
100
96
94
90
86
84
80
76
72
68
64
60
56
52
48
44
40
36
32
28
24
20
16
12
8
4

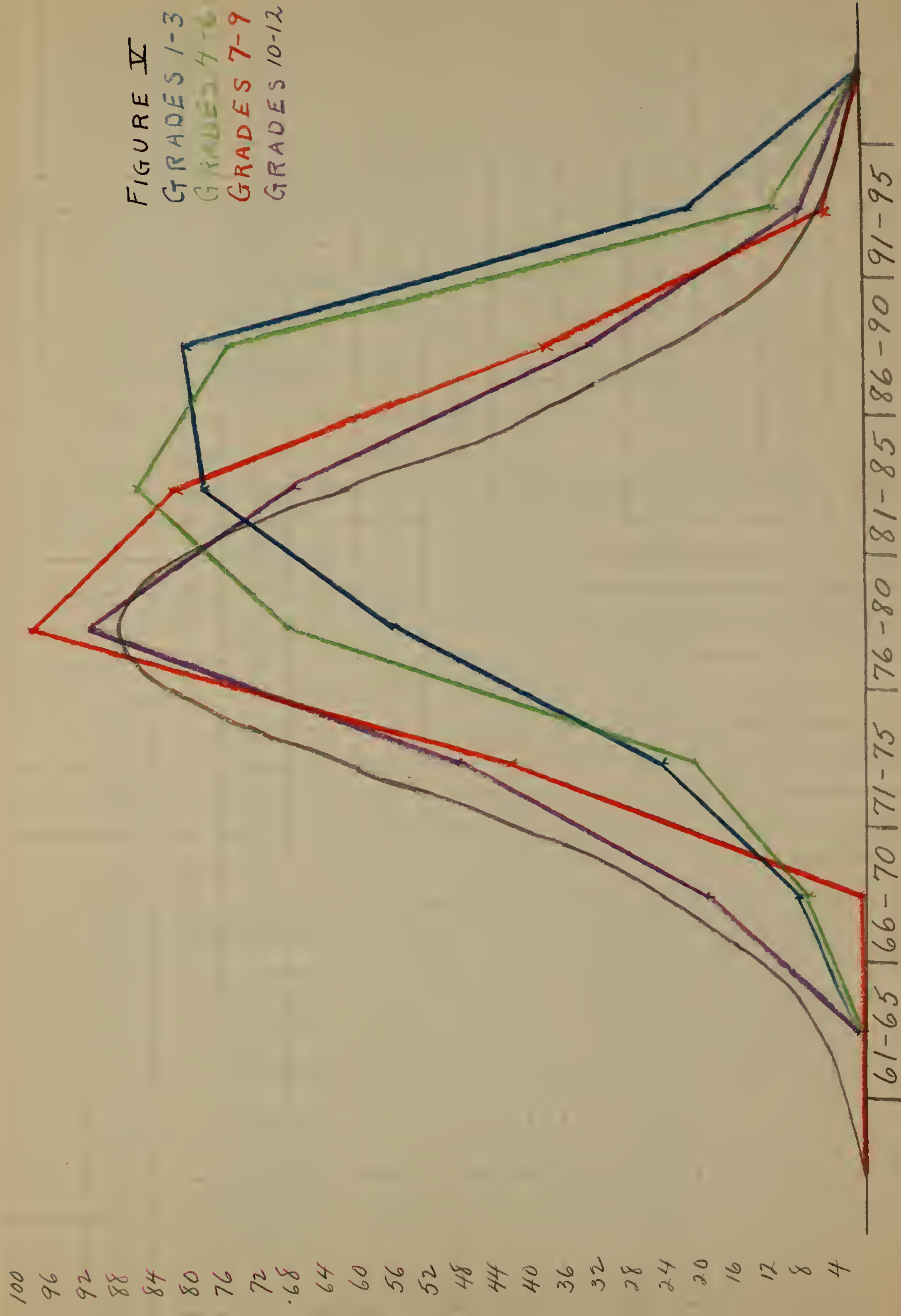
FIGURE VI
GRADES 1-3
GRADES 4-6
GRADES 7-9
GRADES 10-12
61-65
66-70
71-75
76-80
81-85
86-90
91-95
100
96
92
88
84
80
76
72
68
64
60
56
52
48
44
40
36
32
28
24
20
16
12
8
4

TABLE IV

GRADES I - III

Step Interval	Frequency
61-65	1
66-70	6
71-75	25
76-80	55
81-85	78
86-90	80
91-95	21

TABLE V

GRADES IV - VI

Step Interval	Frequency
61-65	0
66-70	8
71-75	21
76-80	66
81-85	86
86-90	75
91-95	10

TABLE VI

GRADES VII-IX

Step Interval	Frequency
61-65	1
66-70	1
71-75	42
76-80	98
81-85	81
86-90	38
91-95	5

TABLE VII

GRADES X - XII

Step Interval	Frequency
61-65	1
66-70	19
71-75	49
76-80	90
81-85	67
86-90	33
91-95	7

present instance: The range is the most general measure of "spread" or "scatter" and may be defined simply as the interval between the largest and the smallest measures. It includes 100% of the distribution, and is employed in making a rough comparison of two or more groups for variability. Since the range only takes account of the extremes of the series, it is obviously unreliable when frequent or large gaps occur in the distribution of scores.

The quartile deviation or Q, may be defined as one half of the distance between the 75th and the 25th percentile points in a given distribution. The 25th percentile or Q_1, is the first quarter or quartile point on the scale; the point below which lie 25% of the measures. In like manner the 75th percentile, or Q_3 is the third quarter or quartile point on the scale, the point below which lie 75% of the measures. The median might also be called Q_2, the second quartile point. In order to find Q it is obvious that we must first calculate the

75th and 25th percentile points. These points are found in exactly the same way as the median, that is to find Q_1 we count off 25% of the scores from the beginning of the distributions; to find Q_3 we count off 75% of the scores from the beginning of the distribution.

The quartile points are of considerable importance in that they mark off the limits within which fall the middle 50% of the measures in the distribution. The distance between these points is here called the inter-quartile range (I.Q.R.) hence Q is the semi-interquartile range. Q actually measures the average distance of the two quartile points from the median, and because of the ease with which it can be found is a valuable measure of the closeness with which the scores are grouped directly around the median point. If the scores of a distribution are closely packed together, the quartiles will be close together and Q will be small; if the scores are scattered, the quartiles will be relatively far apart and Q will be large.

Table VIII gives these measures of variability and central tendency for the data included in this study. By consulting

TABLE VIII

Grades	Q_1	Q_2	Q_3	I.Q.R.	Q	Average or Mean
1-3	78.08	83.11	87.15	9.08	4.54	83.33
4-6	77.70	82.28	86.03	8.33	4.16	82.34
7-9	76.03	79.55	83.29	7.26	3.63	80.32
10-12	74.75	78.62	82.81	8.06	4.03	79.17

this table it can easily be seen that at every quartile point on the scale each succeeding advance division has the corresponding point lower on the percentage marking range. For example the median is lowest for the high school division, and highest for the primary division.

The bulge in the graph of the Junior high division (Fig.III) is accounted for and verified by the size of the Q as compared with the other three divisions.

This table also impressively brings out the fact that all of the distributions are decidedly compact and tend to pile up considerably about the center. This fact has an important bearing on the coefficient of correlation and will be discussed again later in that connection.

Up to this point we have considered the "skewness" of each frequency polygon with respect to an ideal or ficticious median located at the center of the common range which in these cases places it at point 78 on our X-axis. By taking the actual median of each of the distributions as our mid point or center we may determine how much each curve is skewed with respect to the true normal curve for the distribution under consideration. To plot the points necessary to the construction of a true normal curve for a given distribution is quite a task involving differential equations, and after the graph is completed we must depend upon the eye to measure or estimate the amount of skewness present. Figure VI (page 34) shows such a normal curve superimposed upon the frequency polygon for division 4. There is an easier method of determining skewness from the true normal curve by means of a formula which gives us a precise answer in the form of an arithmetical coefficient.

C. H. Richardson's book "An Introduction to Statistical

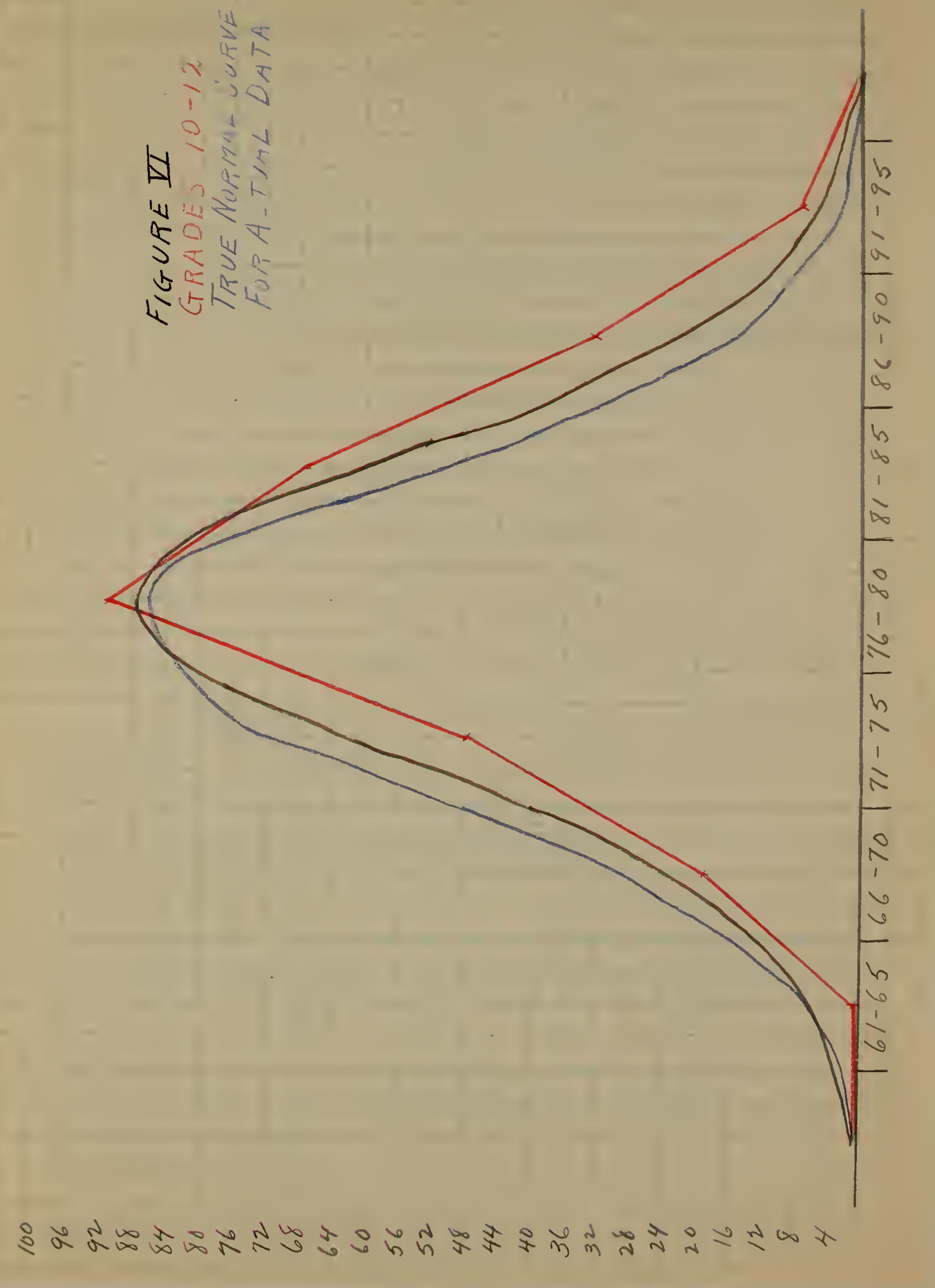
FIGURE VI
GRADES 10-12
TRUE NORMAL CURVE
FOR A-TUAL DATA
100
96
92
88
84
80
76
72
68
64
60
56
52
48
44
40
36
32
28
24
20
16
12
8
4
61-65
66-70
71-75
76-80
81-85
86-90
91-95

Analysis" published in 1934 by Harcourt Brace and Company is the authority upon which the following study of skewness is based. We use the formula:

$$\text{Amount of Skew} = \frac{Q_3 + Q_1 - 2\text{Md.}}{Q_3 - Q_1}$$

Here Q_1, Q_2 and Q_3 stand for the quartile points which are found in Table VIII. Md. stands for the Median or Q_2.

Table IX shows the "coefficients of skewness" obtained by applying this formula to each of the four division distributions.

TABLE IX

Pim.	=	-.11 skew
Int.	=	-.10 skew
J.H.	=	+.03 skew
S.H.	=	+.04 skew
.10	=	moderate amount of skew
.30	=	considerable amount of skew

The total absence of skewness would be represented by a coefficient of .00 while 100% skewness would be represented by 1.00. Richardson states that a coefficient of .10 may be considered as showing moderate skewness while one of .30 shows considerable skewness. Taking this as a standard we can easily see that the Primary and Intermediate distributions are moderately negatively skewed, that is the scores show a moderate tendency to pile up at the high end of the scale. The junior and senior high distributions are very slightly positively skewed, that is the scores show a very slight tendency to pile up toward the low end of the scale.

Thus it may be seen that the primary and intermediate divisions not only have a higher median than the other two divisions but their marks also tend to pile up at the high end of the upper and lower halfs of the scale. In other words they give more A+'s, B+'s and C+'s than do the other two divisions.

To summarize the outstanding facts to be noted in a general survey of this graphic material (1)The lower the grade division the greater the tendency for the marks to pile up on the high side of the scale, (2) The distribution for all divisions is decidedly compact with the junior high division more noticeably so than any of the others.

It must be noted, however, that graphs indicate only a very general relationship between two sets of data and that other statistical methods must be employed in order to show more specific relationships.

The coefficient of correlation method is used to further clarify this study. In calculating the coefficient of correlation the Otis modification of the Personian Product-Moment formula is used as follows:

$$r = \frac{\Sigma x^2 + \Sigma y^2 - \Sigma u^2}{2\sqrt{\Sigma x^2 \quad \Sigma y^2}}$$

Here, Σ means "the sum of", x is the deviation of any score from the mean of one group, while y is the deviation from the mean in the other group, v equals y-x and x, y, and v are measured from arbitary zero points.

The formula is rather complicated; and while the calculation of the coefficient is very easy, the steps are many and one is likely to be overlooked. For that reason it is advisable to use the Otis Correlation Chart shown in Table X (page 38).

Perfect relationship may be expressed by the coefficient of 1.00. For example, if one hundred men take exactly the same arrangement in two tests so that the man who ranks first in one test ranks first in the other, and the man who ranks second in the first test ranks second in the other, and this type of correspondence continues throughout the list, the correlation is perfect, because the relative position of each man is exactly the same in one test as in another.

Chance or no relationship may be expressed by the coefficient of .00.

Relationship may also be negative as well as positive. Such a relationship exists when a large degree of one ability is associated with a small degree of another. When this inverse relationship is perfect, the coefficient of correlation equals -1.00.

The reliability of the coefficient of correlation is impaired by the fact that a general relationship is being determined on the basis of a sample. It is necessary to make allowance for the possibility of the sample not being completely representative of the total. The reliability of the coefficient depends upon first, the size of the coefficient and, second, the number of cases. Incidentally it has been shown empirically as well as theoretically by Yule (7) that the reliability will increase, not in proportion to the number of measures upon which it is based, but rather in proportion to the square root of the number of measures. Thus it is easy to understand the formula for the probable error of the coefficients of correla-

OTIS CORRELATION CHART

PAGE 38.

By Arthur S. Otis, Ph.D.
Author of the Otis Group Intelligence Scale

TABLE X

Correlation between GRADES 10-12 (x) and GRADES 7-9 (y) r_{xy} = .68 ± .02251

N 266 | B 21 | C 803

X-variable class interval (From–To)	X	FX	XFX	X^2	X^2FX	61-65	66-70	71-75	76-80	81-85	86-90	91-95
61–65	2	1	2	4	4			1				
66–70	1	19	19	1	19	1	1	4	12	1		
71–75	0	48	A 354	0				17	23	8		
76–80 (center)	1	91	91	1	91			20	43	24	4	
81–85	2	66	132	4	264				19	37	9	1
86–90	3	33	99	9	297				1	11	21	
91–95	4	8	32	16	128						4	4

Y-variable class interval	61-65	66-70	71-75	76-80	81-85	86-90	91-95
FY	1	1	42	98	81	38	5
Y	2	1	0	1	2	3	4
YFY	2	1	D 394	98	162	114	20
Y^2	4	1	0	1	4	9	16
Y^2FY	4	1	0	98	324	342	80

N 266 | E 3 | F 849

V	FV	V^2	V^2FV
D	1	9	9
C	27	4	108
B	115	1	115
A	123	0	0

Diagonal totals: d 1, c 26, b 69; 1, 55, 123

N 266 | G 232

Correlation Formula

$$r_{xy} = \frac{(C+F-G)-2HJ \div N}{2\sqrt{(C-H^2 \div N)(F-J^2 \div N)}}$$

CALCULATION

A	354		H^2	110889
B	21		$H^2 \div N$	417
A-B	333	H	C	803
D	394		$C-H^2 \div N$	386 P
E	3			
D-E	391	J	J^2	152881
H	333		$J^2 \div N$	575
HJ	130203		F	849
HJ÷N	489		$F-J^2 \div N$	274 Q
2HJ÷N	978	K		

NUMERATOR			DENOMINATOR	
C	803		PQ	105764
F	849		$\sqrt{PQ}$	325
C+F	1652		$2\sqrt{PQ}$	650 S
G	232			
C+F-G	1420	L		
K	978			
L-K	442	M	M÷S	.68 r_{xy} COEF. OF COR.

To find P.E.r

r^2	.4624	
$1-r^2$	.5376	T
$\sqrt{N}$	16	W
T÷W	.0336	Z
.67Z	.02251	P.E.r

To find σ_x

P÷N	1.45	a
$\sqrt{a}$	1.2042	b
C.I.$_x$	5	c
b×c	6.021	σ_x

To find σ_y

Q÷N	1.03	d
$\sqrt{d}$	1.0149	e
C.I.$_y$	5	f
e×f	5.0745	σ_y

To find M_x

HC.I.$_x$	1665	g
g÷N	6	h
M.V.$_x$	73	i
i+h	79	M_x

To find M_y

JC.I.$_y$	1955	k
k÷N	7	m
M.V.$_y$	73	n
n+m	80	M_y

Table of Products

40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
																																		108 1944	90 1620	72 1296	54 972	36 648	18 324
																																		102 1734	85 1445	68 1156	51 867	34 578	17 289
																																	112 1792	96 1536	80 1280	64 1024	48 768	32 512	16 256
																																120 1800	105 1575	90 1350	75 1125	60 900	45 675	30 450	15 225
																														140 1960	126 1764	112 1568	98 1372	84 1176	70 980	56 784	42 588	28 392	14 196
																													143 1859	130 1690	117 1521	104 1352	91 1183	78 1014	65 845	52 676	39 507	26 338	13 169
																											156 1872	144 1728	132 1584	120 1440	108 1296	96 1152	84 1008	72 864	60 720	48 576	36 432	24 288	12 144
																								176 1936	165 1815	154 1694	143 1573	132 1452	121 1331	110 1210	99 1089	88 968	77 847	66 726	55 605	44 484	33 363	22 242	11 121
																					190 1900	180 1800	170 1700	160 1600	150 1500	140 1400	130 1300	120 1200	110 1100	100 1000	90 900	80 800	70 700	60 600	50 500	40 400	30 300	20 200	10 100
																216 1944	207 1863	198 1782	189 1701	180 1620	171 1539	162 1458	153 1377	144 1296	135 1215	126 1134	117 1053	108 972	99 891	90 810	81 729	72 648	63 567	54 486	45 405	36 324	27 243	18 162	9 81
									248 1984	240 1920	232 1856	224 1792	216 1728	208 1664	200 1600	192 1536	184 1472	176 1408	168 1344	160 1280	152 1216	144 1152	136 1088	128 1024	120 960	112 896	104 832	96 768	88 704	80 640	72 576	64 512	56 448	48 384	40 320	32 256	24 192	16 128	8 64
280 1960	273 1911	266 1862	259 1813	252 1764	245 1715	238 1666	231 1617	224 1568	217 1519	210 1470	203 1421	196 1372	189 1323	182 1274	175 1225	168 1176	161 1127	154 1078	147 1029	140 980	133 931	126 882	119 833	112 784	105 735	98 686	91 637	84 588	77 539	70 490	63 441	56 392	49 343	42 294	35 245	28 196	21 147	14 98	7 49
240 1440	234 1404	228 1368	222 1332	216 1296	210 1260	204 1224	198 1188	192 1152	186 1116	180 1080	174 1044	168 1008	162 972	156 936	150 900	144 864	138 828	132 792	126 756	120 720	114 684	108 648	102 612	96 576	90 540	84 504	78 468	72 432	66 396	60 360	54 324	48 288	42 252	36 216	30 180	24 144	18 108	12 72	6 36
200 1000	195 975	190 950	185 925	180 900	175 875	170 850	165 825	160 800	155 775	150 750	145 725	140 700	135 675	130 650	125 625	120 600	115 575	110 550	105 525	100 500	95 475	90 450	85 425	80 400	75 375	70 350	65 325	60 300	55 275	50 250	45 225	40 200	35 175	30 150	25 125	20 100	15 75	10 50	5 25
160 640	156 624	152 608	148 592	144 576	140 560	136 544	132 528	128 512	124 496	120 480	116 464	112 448	108 432	104 416	100 400	96 384	92 368	88 352	84 336	80 320	76 304	72 288	68 272	64 256	60 240	56 224	52 208	48 192	44 176	40 160	36 144	32 128	28 112	24 96	20 80	16 64	12 48	8 32	4 16
120 360	117 351	114 342	111 333	108 324	105 315	102 306	99 297	96 288	93 279	90 270	87 261	84 252	81 243	78 234	75 225	72 216	69 207	66 198	63 189	60 180	57 171	54 162	51 153	48 144	45 135	42 126	39 117	36 108	33 99	30 90	27 81	24 72	21 63	18 54	15 45	12 36	9 27	6 18	3 9
80 160	78 156	76 152	74 148	72 144	70 140	68 136	66 132	64 128	62 124	60 120	58 116	56 112	54 108	52 104	50 100	48 96	46 92	44 88	42 84	40 80	38 76	36 72	34 68	32 64	30 60	28 56	26 52	24 48	22 44	20 40	18 36	16 32	14 28	12 24	10 20	8 16	6 12	4 8	2 4
40 40	39 39	38 38	37 37	36 36	35 35	34 34	33 33	32 32	31 31	30 30	29 29	28 28	27 27	26 26	25 25	24 24	23 23	22 22	21 21	20 20	19 19	18 18	17 17	16 16	15 15	14 14	13 13	12 12	11 11	10 10	9 9	8 8	7 7	6 6	5 5	4 4	3 3	2 2	1 1
40	**39**	**38**	**37**	**36**	**35**	**34**	**33**	**32**	**31**	**30**	**29**	**28**	**27**	**26**	**25**	**24**	**23**	**22**	**21**	**20**	**19**	**18**	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
40 40	39 39	38 38	37 37	36 36	35 35	34 34	33 33	32 32	31 31	30 30	29 29	28 28	27 27	26 26	25 25	24 24	23 23	22 22	21 21	20 20	19 19	18 18	17 17	16 16	15 15	14 14	13 13	12 12	11 11	10 10	9 9	8 8	7 7	6 6	5 5	4 4	3 3	2 2	1 1
80 160	78 156	76 152	74 148	72 144	70 140	68 136	66 132	64 128	62 124	60 120	58 116	56 112	54 108	52 104	50 100	48 96	46 92	44 88	42 84	40 80	38 76	36 72	34 68	32 64	30 60	28 56	26 52	24 48	22 44	20 40	18 36	16 32	14 28	12 24	10 20	8 16	6 12	4 8	2 4
120 360	117 351	114 342	111 333	108 324	105 315	102 306	99 297	96 288	93 279	90 270	87 261	84 252	81 243	78 234	75 225	72 216	69 207	66 198	63 189	60 180	57 171	54 162	51 153	48 144	45 135	42 126	39 117	36 108	33 99	30 90	27 81	24 72	21 63	18 54	15 45	12 36	9 27	6 18	3 9
160 640	156 624	152 608	148 592	144 576	140 560	136 544	132 528	128 512	124 496	120 480	116 464	112 448	108 432	104 416	100 400	96 384	92 368	88 352	84 336	80 320	76 304	72 288	68 272	64 256	60 240	56 224	52 208	48 192	44 176	40 160	36 144	32 128	28 112	24 96	20 80	16 64	12 48	8 32	4 16
200 1000	195 975	190 950	185 925	180 900	175 875	170 850	165 825	160 800	155 775	150 750	145 725	140 700	135 675	130 650	125 625	120 600	115 575	110 550	105 525	100 500	95 475	90 450	85 425	80 400	75 375	70 350	65 325	60 300	55 275	50 250	45 225	40 200	35 175	30 150	25 125	20 100	15 75	10 50	5 25
240 1440	234 1404	228 1368	222 1332	216 1296	210 1260	204 1224	198 1188	192 1152	186 1116	180 1080	174 1044	168 1008	162 972	156 936	150 900	144 864	138 828	132 792	126 756	120 720	114 684	108 648	102 612	96 576	90 540	84 504	78 468	72 432	66 396	60 360	54 324	48 288	42 252	36 216	30 180	24 144	18 108	12 72	6 36
280 1960	273 1911	266 1862	259 1813	252 1764	245 1715	238 1666	231 1617	224 1568	217 1519	210 1470	203 1421	196 1372	189 1323	182 1274	175 1225	168 1176	161 1127	154 1078	147 1029	140 980	133 931	126 882	119 833	112 784	105 735	98 686	91 637	84 588	77 539	70 490	63 441	56 392	49 343	42 294	35 245	28 196	21 147	14 98	7 49
320 2560	312 2496	304 2432	296 2368	288 2304	280 2240	272 2176	264 2112	256 2048	248 1984	240 1920	232 1856	224 1792	216 1728	208 1664	200 1600	192 1536	184 1472	176 1408	168 1344	160 1280	152 1216	144 1152	136 1088	128 1024	120 960	112 896	104 832	96 768	88 704	80 640	72 576	64 512	56 448	48 384	40 320	32 256	24 192	16 128	8 64

Table of Squares

Num.	Square	Num.	Square
11	121	81	65
12	144	82	67
13	169	83	68
14	196	84	70
15	225	85	72
16	256	86	73
17	289	87	75
18	324	88	774
19	361	89	792
20	400	90	810
21	441	91	828
22	484	92	846
23	529	93	864
24	576	94	883
25	625	95	902
26	676	96	921
27	729	97	940
28	784	98	960
29	841	99	980
30	900	100	1000
31	961	101	1020
32	1024	102	1040
33	1089	103	1060
34	1156	104	1081
35	1225	105	1102
36	1296	106	112
37	1369	107	1144
38	1444	108	1166
39	1521	109	1188
40	1600	110	1210
41	1681	111	1232
42	1764	112	1254
43	1849	113	1276
44	1936	114	1299
45	2025	115	1322
46	2116	116	1345
47	2209	117	1368
48	2304	118	1392
49	2401	119	1416
50	2500	120	1440
51	2601	121	1464
52	2704	122	1488
53	2809	123	1512
54	2916	124	1537
55	3025	125	1562
56	3136	126	1587
57	3249	127	1612
58	3364	128	1638
59	3481	129	1664
60	3600	130	1690
61	3721	131	1716
62	3844	132	1742
63	3969	133	1768
64	4096	134	1795
65	4225	135	1822
66	4356	136	1849
67	4489	137	1876
68	4624	138	1904
69	4761	139	1932
70	4900	140	1960
71	5041	141	1988
72	5184	142	2016
73	5329	143	2044
74	5476	144	2073
75	5625	145	2102
76	5776	146	2131
77	5929	147	2160
78	6084	148	2190
79	6241	149	2220
80	6400	150	2250

tion is:

$$P.E._r = \frac{.67\ (1-r^2)}{\sqrt{N}}$$

The probable error gives the limits within which the subsequent coefficients are likely to fall. If r is large, the P.E. decreases; if small, it increases; if r is 1.00 the P.E. is .00.

The compactness of all the distributions in this study may tend to make the resulting r smaller than it would otherwise be. To quote W. L. Uhl (6) in an article in the Journal of Educational Psychology, January 1919 "The greater the range of variation, the less chance there is for a student who is lowest in one factor to be highest in another. For instance, if there is a range of 100 points, the lowest in one factor will have to move 100 points to be highest in another, while if there is a range of only 50 points, the lowest in one factor will have to move only 50 points to be higher in another."

According to Garrett,(1) "it is customary not to consider a r reliable--as indicative of a correlating at least better than)--unless it is at least four times its P.E. To be certain of a low degree of correlation an r should be five or six times its P.E." Every r in this study is very much greater than six times its P.E. It is therefore safe to assume that our coefficients of correlation are, for all practical purposes, the true r's.

Quoting Garrett (1) again "Strictly speaking, the term 'high correlation' should be applied only to coefficients which are .95 or above. However, in mental, social and educational measurements there are so many actual and potential sources of error due to the variability of the material dealt with, and the relative crudity of the measurements made, that very few tests indeed could meet this requirement. Very seldom do correlations between tests run above .70 or .75 and hence it is probably justifiable, in view of the limitations mentioned, to regard such coefficients as high."

There seems to be fairly general agreement among workers with educational and psychological material that the following is a good tentative classification.

r from .00 - .20 denotes indifferent or negligible relation
r from .20 - .40 denotes low correlation: present but slight
r from .40 - .70 denotes substantial or marked relationship
r from .70 -1.00 denotes high relationship.

It must be admitted however that this is a very general and rough criteria by which to judge and interpret the meaning of a coefficient of correlation.

The standard error of estimate written S or σ (est) is probably the most practical way of evaluating the effectiveness of an r. The formula for finding σ (est) is written σ (est) = $\sigma_x \sqrt{1-r^2}$

The probable error of estimate written P.E. (est) may be used for estimating the accuracy of a prediction instead of O (est). P.E. (est) is obtained by simply multiplying O (est) by the constant .6745. Thus

$$\text{P.E. (est)} = .6745 \times \sigma(\text{est}) \sqrt{1-r^2}$$

Table XI shows the coefficient of correlation together with their σ (est) and P.E. (est) that have been computed for the different grade divisions in this study. This table (page 41) shows up the roughness and unreliability of the general criteria mentioned on Page and proves the necessity of judging the prognostic value of a correlation from its σ (est) or its P.E. (est).

TABLE XI

	r	σ(est)	P.E. (est)
Prim - S.H. =	.43 -	5.4720 --	3.6629
Prim - J.H. =	.49 -	5.2896 --	3.5436
Prim - Int. =	.62 -	4.7424 --	3.1758
Inter- S.H. =	.56 -	4.5401 --	3.0118
Inter- J.H. =	.68 -	3.9931 --	2.6733
J. H.- S.H. =	.68 -	3.7011 --	2.4790
1-9 - S.H. =	.61 -	3.0070 --	2.0100
1-6 - J.H. =	.61 -	3.2550 --	2.1775

The following statements of probability based on deductions from Table X are perhaps the best way of summarizing the outstanding observations brought out by the correlation method.

(1) The lower grade division will forecast the mark of the upper grade division with which it is compared in the table within I O(est) two out of 3 times. (More exactly 68 out of 100 times).

(2) The lower division will forecast the mark of the upper division with which it is compared in the table within - 3 O (est) every time.

(3) The chances are even that the lower grade division will forecast the mark of the upper grade division with which it is compared in the table within 1 P.E. (est).

For example a junior high division average will forecast a senior high division average within -3.7 points 2 out of 3 times, or within -11.1 points every time.

The nearer the divisions are together chronologically the more reliable is their forecasting, for example the Junior High Division does the best forecasting of high school marks of any division. A composite of all divisions in grades 1-9 does better high school forecasting than any single division. This fact is not discernable from a study of the r's alone; the σ (est) however makes this obvious.

We may state the forecasting ability in terms of the seven step intervals into which our entire scale or range of marks is divided in the following manner. Since 5 points $\pm$ will take the score only one step interval above or below, it may be said that two out of three times an intermediate or junior high division score will forecast a senior high division score within $\pm$ one step interval.

The quartile placement method is the final type of statistical comparison between the marks in one division with those of the other divisions. Quartiles are the quarters or fourths of a series ranked consecutively from low to high. The method of finding the quartile points and their meaning is the same in this instance as that described on Page   in connection with the graphic method of interpretation.

Table XII (Page 43) shows the quartile placement for each of the 266 cases in each separate division.

TABLE XII

Student Number	Grades 1-3	Grades 4-6	Grades 7-9	Grades 10-12
1	3	3	3	4
2	3	3	3	2
3	3	1	1	1
4	1	1	2	1
5	2	1	2	2
6	2	4	4	4
7	1	1	2	3
8	4	4	4	3
9	3	2	3	3
10	2	2	2	2
11	2	2	2	1
12	3	4	3	3
13	2	2	1	2
14	4	4	4	4
15	2	1	2	1
16	4	4	2	1
17	1	1	3	2
18	2	4	2	4
19	4	4	3	3
20	2	1	3	1
21	1	1	1	1
22	3	3	2	2
23	3	3	4	4
24	4	4	4	3
25	1	2	1	1

Table XII (continued)

Student Number	Grades 1-3	Grades 4-6	Grades 7-9	Grades 10-12
26	2	3	1	2
27	2	3	4	1
28	1	2	2	2
29	2	2	1	2
30	2	3	3	1
31	4	4	4	4
32	4	3	3	3
33	2	1	2	1
34	1	1	2	2
35	4	3	2	1
36	1	4	4	4
37	4	4	4	2
38	4	4	4	3
39	3	3	4	2
40	3	2	3	1
41	3	4	4	4
42	1	3	4	1
43	3	4	4	4
44	2	2	2	1
45	4	4	2	4
46	4	3	2	1
47	4	4	4	2
48	3	4	3	3
49	4	4	4	4
50	4	4	4	4

Table XII (continued)

Student Number	Grades 1-3	Grades 4-6	Grades 7-9	Grades 10-12
51	4	4	4	4
52	4	4	4	3
53	1	1	2	2
54	4	1	2	3
55	2	1	1	2
56	4	3	3	2
57	2	3	2	2
58	1	1	2	1
59	1	1	2	2
60	4	2	2	2
61	2	2	1	1
62	3	3	2	3
63	4	3	4	3
64	1	2	4	4
65	4	3	4	4
66	3	1	1	2
67	1	2	1	1
68	4	3	1	1
69	3	3	2	1
70	4	4	4	3
71	2	4	3	3
72	3	3	3	3
73	1	1	1	1
74	4	3	3	2
75	3	3	4	3

Table XII (continued)

Student Number	Grades 1-3	Grades 4-6	Grades 7-9	Grades 10-12
76	2	2	3	4
77	2	2	1	2
78	1	1	4	1
79	3	3	2	1
80	2	3	3	2
81	3	1	1	1
82	2	3	2	4
83	3	4	3	3
84	3	2	2	3
85	3	4	4	2
86	4	4	4	4
87	2	1	2	3
88	3	1	1	2
89	2	1	1	3
90	4	2	1	1
91	3	1	1	3
92	2	2	1	3
93	3	3	3	4
94	2	3	1	2
95	2	3	3	3
96	2	2	1	3
97	1	1	2	3
98	1	1	2	1
99	1	1	1	1
100	4	3	3	4

Table XII (continued)

Student Number	Grades 1-3	Grades 4-6	Grades 7-9	Grades 10-12
101	1	1	1	1
102	1	1	1	2
103	3	2	3	3
104	1	1	1	1
105	2	1	3	3
106	4	1	3	3
107	2	3	3	3
108	2	1	2	2
109	2	1	1	1
110	2	1	1	2
111	1	1	1	2
112	1	3	2	2
113	2	3	2	1
114	2	1	1	2
115	3	3	3	3
116	4	3	2	2
117	4	2	2	2
118	3	1	1	2
119	1	2	2	1
120	3	1	2	1
121	1	1	2	3
122	1	1	1	2
123	4	4	4	4
124	1	1	1	1
125	2	1	1	2

Table XII (continued)

Student Number	Grades 1-3	Grades 4-6	Grades 7-9	Grades 10-12
126	3	1	2	2
127	4	3	4	4
128	3	2	4	4
129	1	1	1	1
130	2	3	4	4
131	3	2	3	3
132	1	1	1	1
133	1	1	1	1
134	2	2	2	3
135	1	1	3	1
136	2	1	2	2
137	2	2	1	2
138	2	1	1	1
139	3	3	2	1
140	3	1	3	2
141	1	1	1	1
142	3	2	2	2
143	3	1	3	3
144	2	2	3	2
145	4	1	3	3
146	1	2	2	2
147	3	4	4	4
148	1	1	1	1
149	1	1	4	2
150	4	4	4	4

Table XII (continued)

Student Number	Grades 1-3	Grades 4-6	Grades 7-9	Grades 10-12
151	1	1	1	1
152	3	3	4	4
153	3	3	2	1
154	1	1	3	3
155	4	2	2	1
156	4	4	4	3
157	4	3	4	4
158	3	2	2	2
159	1	1	1	2
160	1	1	4	4
161	1	1	1	1
162	2	2	1	1
163	2	1	1	1
164	2	4	4	4
165	2	4	3	3
166	3	3	3	4
167	2	2	3	4
168	1	2	1	1
169	1	3	3	4
170	4	3	1	1
171	2	3	2	4
172	2	1	1	2
173	2	3	2	3
174	4	3	3	3
175	1	1	1	1

Table XII (continued)

Student Number	Grades 1-3	Grades 4-6	Grades 7-9	Grades 10-12
176	2	2	2	2
177	3	3	2	3
178	1	1	1	3
179	3	2	3	1
180	2	3	3	4
181	1	1	1	1
182	3	2	2	2
183	3	3	2	4
184	1	2	1	1
185	4	3	3	4
186	1	4	2	2
187	1	1	2	2
188	2	1	1	1
189	4	4	2	3
190	1	2	2	3
191	3	3	2	2
192	4	4	3	2
193	4	4	4	4
194	4	4	4	4
195	3	3	1	2
196	4	4	4	4
197	2	3	1	3
198	4	3	2	3
199	1	3	4	4
200	2	3	3	3

Table XII (continued)

Student Number	Grades 1-3	Grades 4-6	Grades 7-9	Grades 10-12
201	1	2	1	1
202	3	4	4	2
203	1	3	2	1
204	2	3	3	4
205	4	3	4	1
206	1	2	2	1
207	1	1	3	2
208	1	2	2	1
209	2	4	3	3
210	1	3	3	2
211	4	4	3	4
212	4	4	4	4
213	4	4	4	4
214	1	2	1	2
215	4	4	4	4
216	3	3	2	1
217	4	4	4	4
218	3	4	4	4
219	1	2	1	1
220	3	3	2	3
221	3	3	1	2
222	3	3	2	2
223	4	4	2	2
224	2	2	2	1
225	1	4	4	2

Table XII (continued)

Student Number	Grades 1-3	Grades 4-6	Grades 7-9	Grades 10-12
226	1	2	1	1
227	2	1	1	2
228	2	3	4	4
229	2	2	2	3
230	2	3	1	4
231	4	4	3	3
232	4	4	4	4
233	3	4	3	3
234	4	4	4	4
235	3	3	2	2
236	4	4	4	3
237	4	2	4	2
238	3	4	2	3
239	3	4	4	2
240	1	2	4	3
241	1	1	1	1
242	1	2	2	2
243	4	4	4	3
244	3	2	2	4
245	3	3	4	4
246	4	4	4	4
247	4	4	4	4
248	4	4	4	4
249	3	3	3	2
250	4	3	4	3

Table XII (continued)

Student Number	Grades 1-3	Grades 4-6	Grades 7-9	Grades 10-12
251	1	3	3	4
252	3	4	1	2
253	3	1	1	2
254	3	4	3	4
255	1	4	4	3
256	3	2	2	1
257	2	2	1	2
258	2	3	2	2
259	4	2	4	3
260	4	4	4	4
261	4	4	4	4
262	4	4	4	4
263	2	2	2	1
264	4	4	4	3
265	4	4	4	4
266	2	3	4	4

Table XIII (Page 54) shows a summary of the data contained in Table XII.

The column in the Table XIII designated "Total Misplacement" indicates the number of students who are not in the same quartile in both of the grade divisions under comparison. The column designated "point misplacement" indicates the total number of point of misplacement from the same quartile. For example, a difference of one quartile would be a point misplacement of one point. The coefficient of correspondence is mere-

TABLE XIII

Comparison Between:	Same Quartile	Difference 1 Quartile	Difference 2 Quartile	Difference 3 Quartile	Total Misplacement	Total Misplacement	Coefficient Correspondence
Primary and Intermediate	128	101	30	7	138	182	48.12
Primary and Junior High	110	108	35	13	156	217	41.35
Primary and Senior High	103	107	42	14	163	233	38.72
Intermediate and Junior High	132	100	30	4	134	172	49.62
Intermediate and Senior High	100	121	43	2	166	213	37.59
Junior High and Senior High	130	106	26	4	136	170	48.87

ly the percentage of those who are in the same quartile in both divisions under consideration.

These results agree with the coefficient of correlation method and make it possible to state the relationships in terms of quarters or quartiles. It might again be stated that the nearer the divisions are together chronologically the greater is their degree of forecasting reliability. For example we might say that approximately 50% of the pupils in the highest quarter of their class in junior high will also be in the highest quarter of their class in high school while only 38% will maintain their quartile position of the primary division when they get to high school.

It might be stated here that the efficiency of forecasting upper grade marks by lower grade marks is a relative thing and can only be understood and evaluated in comparison with other forecasting criteria available. Very few standardized achievement or intelligence tests correlate higher with upper grade sc school marks than do the lower grade averages taken as our criteria. It therefore seems reasonable to make the statement that lower grade marks forecast upper grade marks as well as, if not better than, any criteria available.

The check data collected verifies and corroborates the data contained in the 266 cases of our study. Table XIV (Page 56) shows the quartile points and the Q's of the distribution of the June and February high school classes of 1933 as compared with the high school division contained in our study. All points considered are within a fraction of one another.

TABLE XIV

Class Group	Q_1	M	Q_3	I.Q.R.	Q
Study Data	74.75	78.62	82.81	8.06	4.03
June Class 1933	75.20	79.37	83.32	8.12	4.06
February Class 1933	75.91	78.94	82.42	6.51	3.26

Table XV shows the comparison in terms of percent of the number of different marks given in each of our grade divisions during the current marking period. This table together with the data contained in the main study bears out the contention that too many A's are given in the lower grades, and verifies the skewness comparisons brought out by Figure V. Thus the check data proves that our 266 cases in this study is a good "fair sampling" and an excellent practical measure of the actual distribution of all possible cases.

TABLE XV

Division	% of #1's	% of #2's	% of #3's	% of #4's	% of #5's
Division I Grades 1-3	55.45	30.27	10.61	3.13	0.54
Division II Grades 4-6	43.29	30.28	17.53	6.64	2.29
Division III Grades 7-9	23.12	34.45	29.90	9.60	2.91
Division IV Grades 10-12	18.1	35.8	38.9	4.1	2.6

The attempt to study the tie up between conduct ratings and marks met with little if any success. About 90% of the pupils receive an A or B in this subject while about 8% get C's and only two out of a hundred receive D's in but one of the 4 grade divisions. The D's and C's have no regular noticeable effect in changing the mark either positively or negatively. There are several factors in this study which make it advisable to throw out the whole conduct vs. marks problem in this instance. (1) The requisite of graduation from high school for inclusion in this study eliminates those with chronic poor conduct ratings. (2) Teachers probably give a large number of A and B conduct ratings anyway. (3) It is impossible to summarize the teacher--pupil--conduct emotional reaction and its effect on the pupils average by studying a conduct mark alone.

CHAPTER IV

SUMMARY AND CONCLUSION

The problem of this study is to investigate the predictive value of lower grade marks in determining upper grade marks within the Pittsfield school system.

The following statistical methods are employed for the purpose of interpreting the data contained in the 266 cases involved: (1) graphical, (2) coefficient of correlation and (3) quartile placement.

The results of the three statistical methods employed corroborate one another as well as the current marking check material and appear to verify the following conclusions.

(1) Lower grade marks do forecast upper grade marks as well as, if not better than, any other criteria available. (2) The nearer together the grade divisions are chronologically the greater the forecasting efficiency. For example the junior high division average forecast high school division averages better than do the primary or intermediate grade divisions. (3) The best criteria for forecasting high school averages is the pupil's general average for grades 1-9 inclusive. (4) The office record card is an excellent source of student scholastic-ability information. (5) Teachers in lower grades give too many high marks, while the teachers in junior and senior high have a tendency to pile up their marks too much above the median or center. (6) Whatever it is that teachers' marks measure, be it intelligence, achievement or ability to conform and "get along" they are fairly consistent about it from the primary grades through high school.

RECOMMENDATIONS

The following recommendations or suggestions for improving the quality and reliability of marks in the Pittsfield school system are an outgrowth of the study.

(1) The teachers should become familiar with the basic laws of probability necessary to an understanding of the normal curve and its relation to the distribution of their marks. The principals should encourage their teachers to check up on the percentage of A's, B's, C's, D's, and F's given and seek an explanation for radical departures from the normal distribution.

(2) The information available on the office record card should be used in guiding pupils in their choice of courses and electives in high school.

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Date ______________